

Science GIR class enrollment drops

Registration data reveals significant impact of experimental P/NR policy

By Soomin Chun

Preliminary registration data following the implementation of the Pass/No Record experiment for the Class of 2022 shows significant changes, according to Vice Chancellor Ian Waitz in an interview with *The Tech*. Compared to last year, there were over 500 fewer enrollments in the core Science, Mathematics, and Engineering (SME) GIRs, especially in biology and chemistry.

The number of students taking three or four SME GIRs in their first semester decreased from 76 percent in 2017 to 45 percent this fall, according to class registration data as of Sept. 16. Instead, students took more “exploratory courses,” with the number of unique classes that first-years registered for increasing by 10 percent.

In the 2018 Orientation Survey sent out by the Office of the Vice Chancellor, the number of students who said it was “very important” that a subject fulfilled requirements dropped, whereas the number of students marking “a chance to explore

a potential department in which to major,” “interesting material,” and “chance to learn something new” as very important increased, both relative to last year.

The OVC will compile a more extensive set of comparisons after add date, according to Waitz.

These data points are the result of an experiment led by the OVC and approved by the Committee on the Undergraduate Program in July. As part of it, students in the Class of 2022 are eligible to designate up to three additional SME GIRs to be graded as P/NR after their first semester.

“I decided not to take any GIRs this semester and instead take some computer science classes to try and see if I would be interested in that,” Daniel Sun ’22 said in an interview with *The Tech*. Sun is currently a Course 18 considering Course 6 as well.

“Since I can get GIR classes on P/NR later, I chose not to take any GIRs this semester so I can get more P/NR classes overall,” Akshaj Kadaveru ’22

GIRs, Page 2



MAHI SHAFIULLAH—THE TECH

TechMart, a grocery store that opened in the Walker Memorial building Monday, aims to provide at-cost groceries to students after Star Market closed down in the spring.

At-cost grocery store opens in Walker Memorial this week

TechMart offers produce, dairy, bread, frozen food

By Rujul Gandhi

TechMart, an at-cost grocery store for MIT students, opened Monday in Walker Memorial (Building 50). Since the closing of Star Market, a popular, close-to-campus destination for affordable groceries, in February, students have needed an alternative.

TechMart offers a selection of fruits, vegetables, dairy, bread, sauces, frozen food, and spices, among other items. All the produce is “at-cost,” which means no mark-up is charged on the price at which it is obtained from the wholesaler. Milk at TechMart costs \$2.26, an apple costs \$0.49, bread costs \$1.50, and a carton of eggs costs \$1.79.

The shop is located at and operated by Rebecca’s Cafe, on the second floor of Walker. TechMart accepts dining dollars (with the standard five percent discount) as well as TechCash, and operates from 3–11 p.m. on weekdays. It is closed on weekends.

The logistics of setting up TechMart were managed by the Division of Student Life, according to a statement from Mark Hayes, director of campus dining, in an email to *The Tech*. Staff from DSL and a committee of students from various undergraduate and graduate associations worked on the location and produce selection.

The store has been positively received by students so far.

Ajay Jain ’20, who lives in East Campus and cooks for himself, told *The Tech* in an interview that he finds the location convenient for East Campus residents. Deeksha Sinha G, while happy with the prices, said that TechMart could improve in terms of selection of items.

TechMart is a pilot project being undertaken to reduce food insecurity at MIT. In September 2017, a survey by the student group Class Awareness, Support, and Equality (CASE) found that 11.6 percent of undergraduates could not afford food at some point during their time at MIT.

In response, the Food Inse-

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MIT's first humanist chaplain

Greg Epstein encourages discussions about ‘why’

By Kelly Wu

MIT’s Office of Religious Life is welcoming Greg Epstein as its first-ever humanist chaplain at the Institute. The other chaplains are enthusiastic about the new hiring, since they recognize that there is a large group of secular and nonreligious people at MIT, Epstein said in an interview with *The Tech*.

Meetings with faculty, deans, and administrators have been positive, and the MIT community overall has been pleasantly surprised with the addition, Epstein said. Epstein hopes to begin meeting with students soon, as the fall semester is underway.

When asked to explain humanism, Epstein quoted the title of his book: “good without God.” He explained humanism as a secular way

of living an ethical and meaningful life. A humanist outlook stresses the importance of thinking about the why of one’s life and holds that the answer lies in human connections. According to Epstein, humans are social, and so they should create ethical, respectful, and meaningful relationships with each other that eventually benefit society.

Epstein views his role as humanist chaplain to be that of a supporter, listener, and discussion facilitation leader for the students and the MIT community. “I really want students to make big decisions as thoughtfully as they can,” Epstein said.

Epstein said that at MIT, students are working hard to succeed in classes, plan startups, and land internships and jobs at the companies of their dreams, but students should put an equal amount of en-

ergy into figuring out why they want to succeed. He said he “knew people who worked so hard for money that they gave up chances to be with family, [and] make a difference in the world.”

Epstein believes it is essential to have the “why” discussion now, when students are young, rather than later in life. Most importantly, Epstein wants to facilitate conversations between students, specifically conversations about supporting one another, accepting vulnerabilities, and finding personal purpose in life.

One specific way that Epstein is getting involved with student campus life is through a new weekly discussion-based event. Epstein has partnered with Student Minister Nina Lytton SM ’84 to offer a dis-

Chaplain, Page 2

MIT Corp. member Bodman dies at 79

Bodman served as Sec. of Energy

By Susanna Chen

Samuel Bodman ScD ’65, a member of the MIT Corporation and former U.S. Secretary of Energy, died Sept. 7 in El Paso, Texas after a long battle with primary progressive aphasia. He was 79.

After receiving a bachelor’s degree in chemical engineering from Cornell University, Bodman joined the MIT community, completing a ScD degree in the same field in 1965, according to biographical information compiled by the White House archives. Shortly afterwards, he served as an associate professor of chemical engineering at MIT.

He followed his work in educa-

tion with a career in finance. In 1983, he became the president and chief operating officer of Fidelity Investments. Five years later, he joined Cabot Corporation, a specialized chemicals company, and served as chief executive officer and director.

Bodman was confirmed unanimously by the U.S. Senate to the position of Secretary of Energy under the George W. Bush administration in 2004. As leader of the Department of Energy, he oversaw security issues at the Los Alamos National Laboratory and managed a budget of over \$23 billion.

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WEATHER

Good weather for career fair, another cool down to come

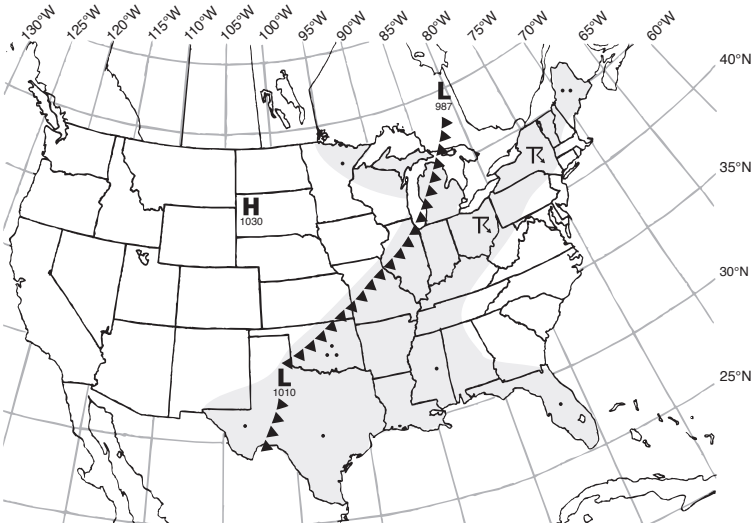
By Jordan Benjamin
STAFF METEOROLOGIST

The weather today will be good for Career Fair activities as a seasonable but breezy and humid air mass over-spreads the area in advance of a strong cold front Friday Night. On Saturday, Boston will begin to transition to very fall-like weather as cool, dry air surges into the region. By Sunday night, temperatures

could dip to around 50°F and high temperatures next week could struggle to edge far above 60°F. This cool, crisp and dry weather will jump start and accelerate the emergence of vivid fall foliage and is a marked transition from the train of humid and/or warm air masses that have in succession dominated our weather over the past few weeks. Get out and enjoy the weekend!

Extended Forecast

Today: Partly cloudy. High around 74°F (23°C). Winds SW at 10–15 mph.
Tonight: A slight chance of showers, otherwise mostly cloudy and breezy. Low around 67°F (19°C). Winds south at around 15 mph.
Tomorrow: Partly cloudy. High around 72°F (22°C). Low around 53°F (12°C). West winds at 10–15 mph becoming north late.
Saturday: Partly cloudy. High around 68°F (20°C). Low around 51°F (11°C).
Sunday: Mostly sunny. High around 63°F (17°C).



Situation for Noon Eastern Time, Friday, September 21, 2018

Weather Systems	Weather Fronts	Precipitation Symbols	Other Symbols
H High Pressure	--- Trough	Snow: * (light), * (moderate), * (heavy)	Fog: ☁
L Low Pressure	— Warm Front	Rain: ▽ (light), ▽ (moderate), ▽ (heavy)	Thunderstorm: ⚡
§ Hurricane	▲▲▲ Cold Front	Light: * (light), * (moderate), * (heavy)	Haze: ☁
	— Stationary Front		

OVC to reform advising

GIRs, from Page 1

said in an interview with *The Tech*. “Also, I can enjoy my first semester more.”

In addition to the new GIR policy, Waitz revealed other developments the OVC is work-

ing on, such as plans to reform advising so that students get a network of advisors instead of one first-year advisor in a random major, as well as a shorter, IAP version of the Designing the First Year class offered last fall.

Epstein serves as ‘convener’

Chaplain, from Page 1

cussion group, where any MIT student can come and discuss topics related to how to live a meaningful, ethical, and community oriented life.

Epstein wants to be able to help people start understanding the impacts of technological change on our basic ideas of community and relationships. MIT, to him, is the best place to start to understand these impacts because the Institute is at the forefront of technological innovation, Epstein said.

Before coming to MIT, Epstein served as humanist chaplain at Harvard for 13 years, starting in 2005, and continues to serve in this role. He is also the author of *Good Without God: What a Billion Nonreligious People Do Believe*, and is frequently cited as one of the leaders of the national humanist movement.

Epstein is also one of five MIT chaplains that serve as “conveners,” people who work to convene meaningful conversations at the Institute, especially between people of different beliefs.

TechMart housed in Rebecca’s Cafe

TechMart, from Page 1

curity Solutions Working Group (FISWG) was created by Chancellor Cynthia Barnhart PhD '88 and Vice President and Dean for Student Life Suzy Nelson. The group published a report in March 2018, with a low-cost grocery market or pantry on campus as one of the key recommendations. The FISWG also found that since most dining options are on the west side of campus while academic buildings are on the east side, students would rather con-

tinue working than travel to the dining halls for meals. TechMart is located in east campus, closer to many academic buildings, and so might be more convenient for students. *The Tech* found about half a dozen shoppers at TechMart on its opening day, but only a few or no shoppers on two subsequent visits. Shoppers in TechMart can give feedback on comment cards, and students can email suggestions about their experience to food-stuff@mit.edu.

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‘He loved MIT,’ M. Diane Bodman says

Bodman, from Page 1

“Sam Bodman has shown himself to be a problem solver who knows how to set goals, and he knows how to reach them,” George W. Bush said in his 2004 remarks on Bodman’s nomination.

Bush also wrote in a statement released Sept. 7, “Sam had a brilliant mind, and [Laura] and I are fortunate that he put his intellect to work for our country as Secretary of Energy. I am proud that he was a member of my Cabinet, and I am proud that he was my friend.”

Along with his nomination to the office of U.S. Secretary of Energy, Bodman also served as the Deputy Secretary of the Treasury and the Deputy Secretary of Commerce.

He later became a member of the MIT Corporation, serving on the Executive and Invest-

ment Committees, before being granted the title of life member emeritus.

“Sam led an extraordinary life of leadership and service in business, academia, and government. MIT was the very fortunate beneficiary of his time, talent, and wisdom in so many different capacities over the years. We are saddened by his loss but grateful for his impact on the Institute and well beyond,” Robert Millard, chair of the MIT Corporation, told MIT News.

Bodman is survived by his wife, M. Diane Bodman, three children, Elizabeth Mott, Sarah Greenhill, and Andrew Bodman, and two step-children, Perry Barber and Caroline Green.

“He loved MIT. He thought it was the finest institution in the world of its kind. He felt MIT really changed his life,” Ms. Bodman told MIT News.

Solution to Got Money?

from page 11

7	8	1	2	9	5	6	3	4
6	7	9	1	8	4	5	2	3
2	3	5	6	4	9	1	7	8
1	2	4	5	3	8	9	6	7
5	6	8	9	7	3	4	1	2
9	1	3	4	2	7	8	5	6
3	4	6	7	5	1	2	8	9
4	5	7	8	6	2	3	9	1
8	9	2	3	1	6	7	4	5

Solution to Not a 6-3

from page 10

4	5	6	1	3	2
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2	3	4	5	1	6
3	4	5	6	2	1

January Scholars in France

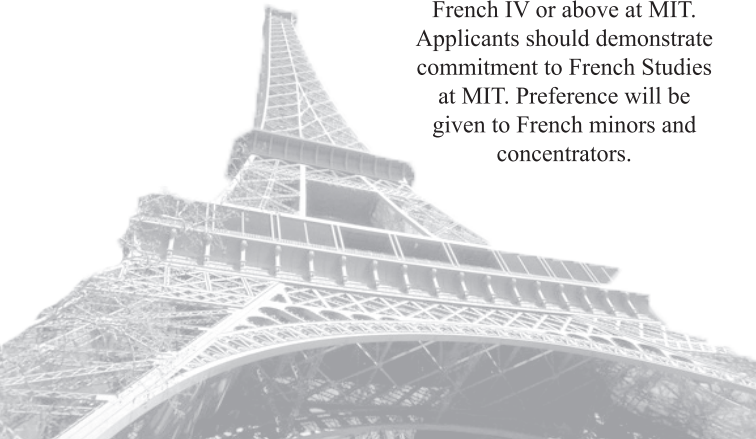
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FEATURE

Evolution of the first year academic experience

A history of the changes in curriculum, policy, and programs affecting the first year at MIT

By Whitney Zhang
FEATURES EDITOR

This year, freshmen can designate up to three Science, Mathematics, and Engineering (SME) General Institute Requirements to be graded on a Pass/No Record basis after their first term. This experiment marks a bold initiative to reevaluate the curriculum of the first year and the broader first-year experience, and a continuation of MIT's increasing encouragement of freshman exploration. In light of the experiment, it is timely to reflect on the history of the first-year academic experience at MIT.

The early years

MIT's first class, in 1865, consisted of only 32 freshmen. The required courses were mathematics, mechanical drawing, free hand drawing, elementary mechanics, chemistry, English language and literature, modern languages, and military tactics. All freshmen took these classes together.

Mathematics included algebra, plane trigonometry, solid geometry, and spherical trigonometry. Elementary Mechanics included the "general doctrine of motions and forces," mechanics of solids, mechanics of liquids and gases, and "phenomena and laws of sound." Chemistry included "chemistry of the non-metallic elements" and "chemistry of the metals." The "modern languages" requirement consisted of learning French and German.

Dr. Deborah Douglas, Director of Collections and Curator of Science and Technology at the MIT Museum, wrote in an email to *The Tech* that learning French and German was necessary because they were the language of most science and technology papers and textbooks. She also explained that drawing was a requirement because in the 19th century, engineering was centered around drawing machines. With the onset of the 20th century, mathematical analyses took precedence, and so the mechanical and free hand drawing classes were gradually phased out.

In addition to classes, all students were required to do drills and receive instruction in military science in the MIT Corps of Cadets. The U.S. Congress passed the Morrill Act in 1862 to provide states with federal lands that could be sold to fund colleges. The Massachusetts legislature's decision to provide funds to MIT included a requirement to "provide instruction in military tactics." Each week, first and second year students trained with each other for an hour and a half, albeit with poor equipment and limited resources.

Beginning in 1908, all first-year students were required to take lectures in personal training and hygiene, exercise two hours a week with an instructor, and complete physical exams at the beginning and end of the school year.

The Lewis Report: Foundations of MIT's HASS system

In 1947, MIT commissioned the Committee on Educational Survey, chaired by Warren K. Lewis. In 1949, the committee published *The Report of the Committee on Educational Survey*, known as the Lewis Report. This report examined MIT's principles of education and provided recommendations for the MIT curriculum that became the foundations of the current MIT academic experience.

At this time, MIT had risen to increased prominence as a result of WWII. In addition, the number of public universities was increasing, bringing into question the value of private higher education. As a result, the committee grappled to es-

tablish MIT's institutional purpose.

The committee decided that MIT must "provide a kind of education that cannot be obtained elsewhere" and could only do so by "improv[ing] the education that we now offer and to extend[ing] it into new and promising areas hitherto undeveloped." The report argued that MIT should create the Committee on Undergraduate Policy in order to "provide a means for concentrated and unified effort toward achieving the distinction in undergraduate education to which the Institute should aspire."

Furthermore, Douglas wrote, at the time there was an "existential issue regarding the real and perceived threat of fascism." Faculty found that course curricula were similar to that of a Soviet university and that "the kind of student MIT was educating was being trained to conceive, design, operate, and manage large technological systems that had the same centralizing tendencies as did communist governing systems." As such, there was an increased emphasis on the preservation of democracy through civics and the humanities.

Thus, during the course of the study, an auxiliary committee, the Committee on General Education, was commissioned in order to focus specifically on providing undergraduates with "broader and more effective cultural training." Their recommendation focused on "strengthening and broadening the facilities for education in the social sciences and the humanities at the Institute" and recommended extending the HASS GIR requirement from 8 subjects to 10 subjects and including HASS subject sequences.

As a result of these recommendations, MIT created the Committee on Undergraduate Policy — now the Committee on the Undergraduate Program (CUP) — which provided a central body to oversee the undergraduate educational program, and the School of Humanities and Social Sciences.

In 1951, the HASS requirement was changed from two terms of composition and six terms of humanities to a four HASS-subject sequence in the first two years, a three-subject concentration in years 3–4, and one elective.

In 1948, the swim test was instated, after a recommendation from the Athletics Association Study Committee. There are many false rumors about the origins of the swim test, including one that posits, "The son of prominent alum X drowns, prompting the alum to donate in the son's name ... under the stipulation that a swim test be required in order to receive a diploma." Years after, the PE requirement was increased to six points, and then to eight points.

The Zacharias Report: Foundations of MIT's science core and distribution requirements

In 1962, MIT commissioned a faculty committee, chaired by Jerrold Zacharias, to review the undergraduate curriculum, particularly the science requirement. The committee report, published in 1964 — referred to as the Zacharias Report — tackled many issues that are still pertinent today, including whether or not students should begin by learning the pure sciences, "whether emphasizing reading- and lecture-based science subjects undermined the 'resourcefulness' and efficacy of students," and the tension between training students for their professions versus enriching them for their broader lives. Ultimately, the report recommended a more diverse and flexible Science Requirement.

Faculty voted to approve the report's recommendations. The sci-

ence core was changed from four semesters of physics, four semesters of math, and two semesters of chemistry to two semesters of physics, two semesters of math, one semester of chemistry, three elective classes, and one elective laboratory subject from a list of Science Distribution subjects.

The Science Distribution classes included subjects like Thermodynamics, Organic Chemistry, Crystallography, and Differential Equations. The Science Distribution laboratory requirement included subjects like Design of Experiment, Engineering Design and Manufacture, and Experimental Electronics.

The elective laboratory was not to teach about a specific subject matter or field, but rather was to "give the students some real idea as to what laboratories are and what is meant by solving experimental problems in science and engineering." The other three electives were meant to be a balance between exposing students to a common core of fundamental science subjects and a recognition of the diversity of students.

The HASS system (developed as a result of the Lewis report) and the science core and science distribution requirements (developed as a result of the Zacharias report) form the basis of the HASS GIR and SME GIR requirements that we have today.

Later changes to the GIRs

In 1974, the HASS requirements were changed to an eight-subject Hum-D distribution requirement, of which students had to take at least three subjects in three separate fields, and a three-subject concentration requirement in a single field, in order to "achieve some degree of depth" in that field.

In 1988, under recommendation from an Institute-wide committee chaired by the late Professor of American History Pauline Maier, the Hum-D distribution requirement was changed to a HASS-D distribution requirement. The change imposed more structure and restricted class selection for the requirement in order to "ensure that students receive a broad and cohesive exposure to the humanities, arts, and social sciences."

In 1990, biology was added to the science core, and the science distribution was replaced with a restricted elective in science and technology and decreased by one subject.

In 2000, the writing requirement was replaced with the communication requirement.

In 2001, the first TEAL class, 8.02T, was instated and deemed a success by faculty. One study found that TEAL doubled student learning gains. However, student reviews were more mixed. In a column in *The Tech*, one student complained that the computers froze during presentations, the slides had typos, and that the problem set questions were vague. These problems were eventually fixed, and, by 2005, almost all physics classes were taught in a TEAL format.

In 2010, the HASS-D distribution requirement was removed and replaced with the current HASS requirement of three distribution components of one HASS-A (arts), one HASS-H (humanities), and one HASS-S (social sciences); three or four subjects in a concentration; and one or two electives.

In 2012, edX was launched and first used by ESG and Concourse for 8.01.

Pass/No Record

In 1968, Pass/Fail was enacted as a four-year experiment for the freshman class in order to ease student anxiety, to help students compensate for differences in secondary school education, to

give students more freedom in choosing classes, and to improve instructor-student relationships. In addition, a credit limit of 60 units in the fall and 63 units in the spring was implemented. Students received feedback through twice-a-term Freshman Evaluation Forms.

Reviews of the unit limit were mixed. Some felt that the limit was good for preventing students from overburdening themselves, but others felt that the limit change was counterproductive to Pass/Fail's purpose of furthering freshman exploration. On the other hand, students were very "overwhelmingly supportive" of Pass/Fail, according to a study done by sociologist Charles L. Stannard in the Spring of 1971. One student wrote a letter published in *The Tech* saying, "If it had not been for pass/fail [sic], I would have drowned."

Asv thus, Pass/Fail was not ended after four years. Instead, in 1973, it was made permanent and changed to Pass/No Record in order to encourage freshmen to further explore classes.

Faculty were concerned about the lack of ability to give students feedback, and so in 1982, formal "hidden grades" were added in the spring.

In 1988, the Committee on the First Year Program, chaired by Kenneth Manning (referred to as the Manning Committee), recommended a more "flexible" first-year program that included ending Pass/No Record in the second semester and changing the minimum "Pass" grade from a C to a D.

Based on the Manning Committee's recommendations, faculty chose to change the minimum "Pass" grade to a C, but did not end Pass/No Record. In addition, they lowered the unit limits to 54 in the fall and 57 in the spring.

In 1995, the Freshmen Evaluation Forms were eliminated and were replaced with formal "hidden grades" for both the fall and spring semesters, as well as a "Fifth Week Flag" that notified students after their fifth week if they were failing a class.

In September 2000, a subcommittee of CUP recommended that freshmen in their spring term be graded on A/B/C/NR instead of Pass/No Record. The change was originally suggested by Professor of Literature Travis R. Merritt and Professor of Anthropology Arthur Steinberg. Steinberg felt that Pass/No Record was leaving students unprepared for their sophomore year. Students, however, strongly preferred Pass/No Record.

The change was approved in 2002. It reduced the number of students who received Ds and Fs in their classes, but sophomore grades did not improve.

This year, in order to foster "a more exploration-focused experience," freshmen can designate up to three SME General Institute Requirements as Pass/No Record after their first term. The Office of the Vice Chancellor recommends that students take one exploratory course their freshman year. This year's policy is an experiment in part resulting from the Designing the First Year, a class targeted at enhancing the first-year experience at MIT. The Class of 2021 will serve as the control group.

Freshman Orientation and Advising

Prior to 1969, All first-years were advised by faculty in a traditional model. By 1975, much fewer faculty were advising students, and 50 percent of advisors were non-faculty and 35 percent were graduate students. Briefly, from 1977–1979, the

Office of Freshman Advising was faculty run.

In 1984, the Freshman Advising Seminar began. In 1992, traditional advising was eliminated. 80 percent of students participated in one of 112 seminars, and the other 20 percent were not advised. At this time, unlike today, most Freshman Advising Seminars were not faculty led.

The earliest evidence of Early Sophomore Standing is in a reference to the Profile of the Freshman Class in 1985. Early Sophomore Standing allows freshman students to become sophomores in their spring semester. Students are graded, advised, and credit-limited as sophomores.

In 1995, the current advising model began. Freshmen were either enrolled in a seminar or traditionally advised.

The first Freshman Pre-Orientation Program (FPOP), "Freshman Leadership Program," debuted in 1996. Around the same time, "Discover Ocean Engineering" (DOE), the first academic exploratory program, debuted. There are now over 25 FPOPs.

Freshman orientation in its modern form began in 1997. Prior to this, orientation activities were "integrated" with fraternity rush and referred to as R/O.

In the 2000s, Residence Based Advising (RBA) was introduced in McCormick Hall, with modified versions in Random Hall, Chocolate City, German House, and Spanish House. Upperclassmen Residence Associate Advisors would work with a faculty/staff advisor to advise a group of 8–10 freshmen. In addition, they would work with Residence Life Associates (RLAs), who would guide the RBA program and provide dormwide events. RLAs eventually evolved into the current Residential Life Area Directors. Initial reviews of RBA were mixed. Some students felt that they could help "build community" in their residences, but others felt that it would deprive students of the ability to join freshman advising seminars and feared that it was endemic of increasing administrative control.

The Freshman Learning Communities

Freshman Learning Communities provide students the opportunity to learn in small, interactive classes within a community-based program and set physical space, and include first-year advising and social activities.

The Experimental Study Group (ESG) began in the fall of 1969 as an educational experiment founded by the Edwin Land Foundation in order to encourage independent work, interpersonal communication, and active student involvement. There were originally no classes (although students could choose to attend regular MIT classes) and students could choose their own topics to study. Students were not required to read from MIT course textbooks or complete assignments. In 1980, ESG was formally given status under the School of Science. ESG offers classes that cover all of the SME GIRs, as well as several HASS classes and seminar options.

Concourse was founded the year after by Professors Louis Bucciarelli and David Oliver of the Department of Aeronautics and Astronautics and sponsored by the Commission on MIT Education in order to establish a cooperative curriculum between the sciences, the humanities, and engineering. Concourse offers classes that cover the mathematics, chemistry, and physics GIRs. Freshmen are required to take CC.110: Becoming Human: Ancient Greek

Perspectives on the Best Life in the fall semester and attend Friday seminars in both terms.

The Integrated Studies Program (ISP) began in 1989 and integrated coursework in the humanities, sciences, and engineering. Students enrolled in SP.353: Technologies and Cultures, and SP.354: Technologies in Historical perspective. Students could also attend a special ISP only 8.01X recitation section. In 2002, ISP was replaced with Terrascope.

Media Arts and Sciences’s (MAS) first-year program was founded in 1999 to introduce students to university research, the Media Lab community, and “intersection of technology and communication/expression.” Students take MAS.II0: Fundamentals of Computational Media Design in the fall and MAS.III: Introduction to Doing Research in Media Arts and Sciences in the spring. MAS offers recitation sections for chemistry and physics

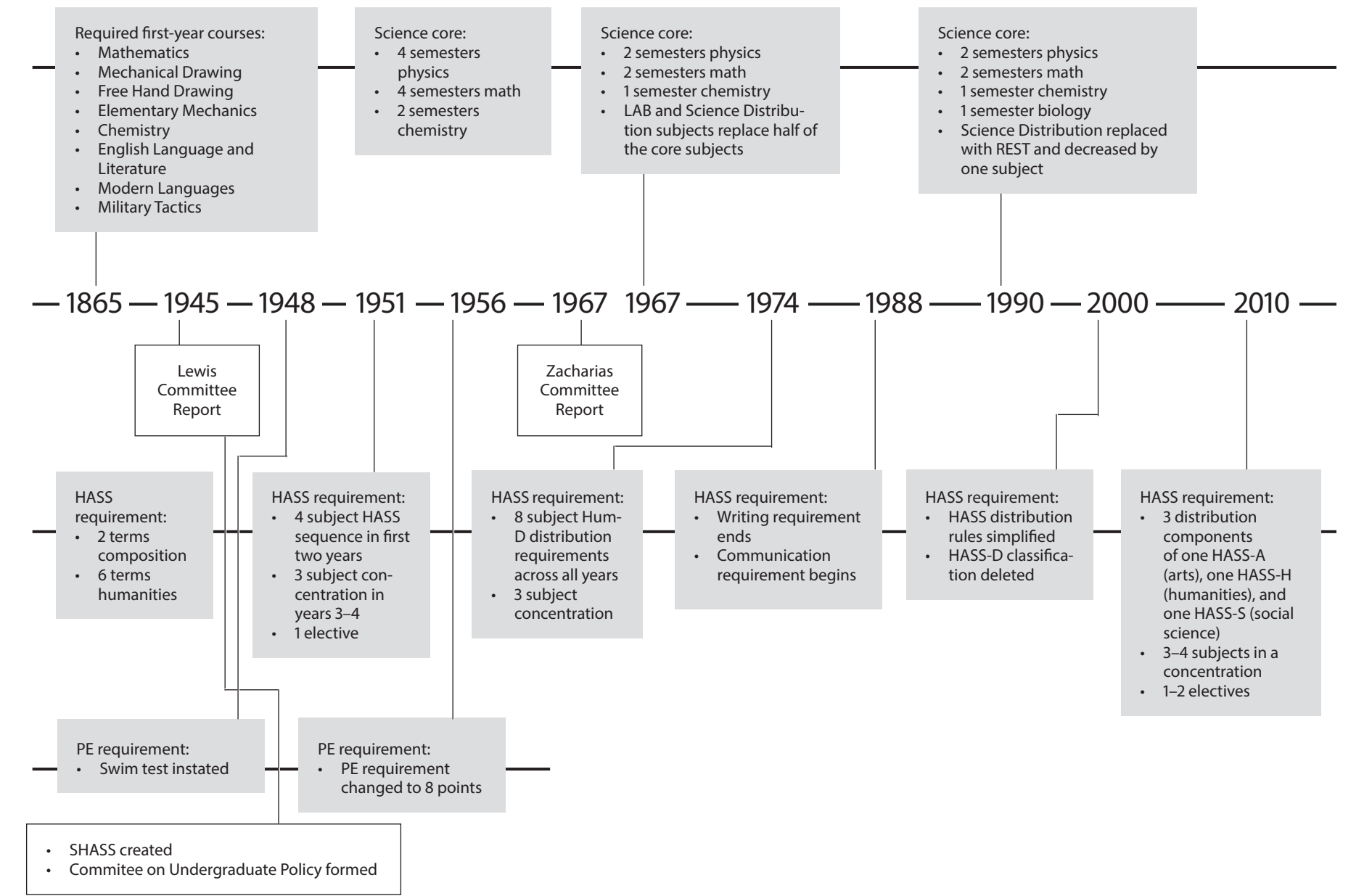
GIRs and a variety of seminars.

Terrascope was founded in 2002 by Civil and Environmental Engineering Professor Sallie “Penny” Chisholm and Professor of Earth, Atmospheric, and Planetary Sciences Kip Hodges as the educational arm of the Earth System Initiative (ESI) (not to be confused with the current Earth Science Initiative). ESI, also formed in 2002, was developed to “foster and facilitate multidisciplinary research and education

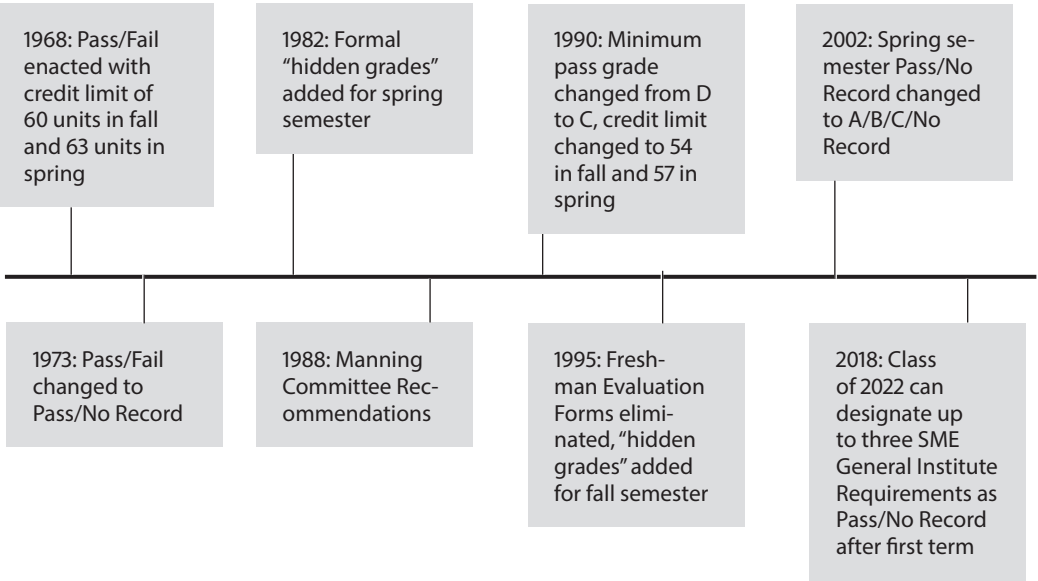
efforts in earth and environmental sciences.” Terrascope grew out of 12.000: Solving Complex Problems, a class created by Hodges in 2000; the class continues to be the cornerstone of the program. The class gives freshmen the opportunity to take charge of their own work by putting them in charge of tackling a “Mission,” a complex earth systems problem. Originally, during the spring semester, students took 1.016: "Design for Complex Environmen-

tal Issues," in which they designed and built museum exhibits. In the current version of the class, now listed as 2.00C[J]/1.016[J]/EC.746[J], students design and prototype specific solutions to aspects of the year’s Mission. Students also have the option of taking SP.360, Terrascope Radio, in which they develop a radio program, and going on a spring break trip to investigate their Mission first-hand. Terrascope does not offer GIR classes.

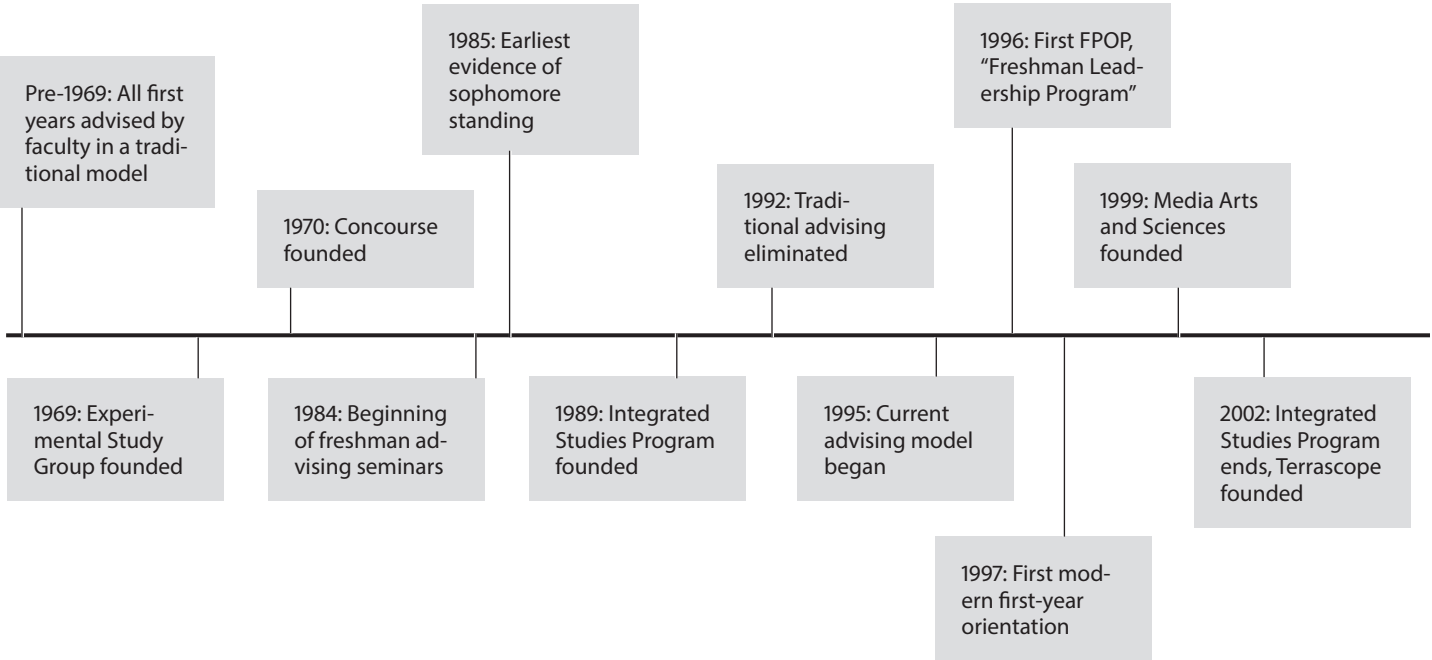
Institute Requirements



Pass/Fail



Orientation, Advising, and Learning Communities



A delightful homage to '80s horror film and revenge flicks, *MANDY* will make you cower, laugh, cry, and most of all, have a great time

Nicolas Cage and Andrea Riseborough both give the performances of a lifetime in this movie, as do — for that matter — most of the cast. The visuals and music are flawless. This movie is so good that I cannot say enough about it, and I fully recommend that you watch and support it. You will not be disappointed. Legion M President Jeff Annison, in my interview with him last week, described *MANDY* as, first and foremost, “batshit crazy,” and he was absolutely right. It’s crazy, it’s fun, it’s terrifying, and it’s beautiful, but most of all, it’s one of the best movies out this year.

where the GDB instructors have to safely drive right at the dog and blindfolded handler. The psychological and cultural aspects of the GDB handlers are also quite interesting. For example, GDB transfers Phil after six months to a more experienced handler, leaving the previous handler devastated, who was unaware that GDB had planned this from the start. The difference in attitudes between the clinical, objective approach of GDB and the emotional attachment of the handlers gives the documentary thought-provoking content. While the direction of *Pick of the Litter* could have been improved, the documentary is worth watching, especially for dog lovers. The film's laidback portrayal of a highly specific community is informative and sometimes even exciting. The dogs are really cute, too. Go, Phil!

Email your pieces to cl@tech.mit.edu!

THEATER REVIEW

Speaking her truth in grad school

Joys and struggles at MIT

Truth Values: One Girl's Romp through MIT's Male Math Maze

Written and Performed by Gioia De Cari

Central Square Theater

Sept. 12–23

By Mark Goldman

Truth Values peeks into the life of Gioia, an MIT Ph.D. candidate in logic, from the moment she gets accepted till she leaves MIT with a master's. Based in the author's own experiences at MIT, this autobiographi-

cal one-woman show portrays the rawness of MIT grad school as I've never seen in theaters before. The subtitle, "one girl's romp through MIT's male math maze," adequately describes the isolation and gender discrimination emphasized through the play. However, the challenges Gioia faced, like finding

friends, switching advisors, and having a father's death impact her graduate studies, speak to truths experienced by many in graduate school.

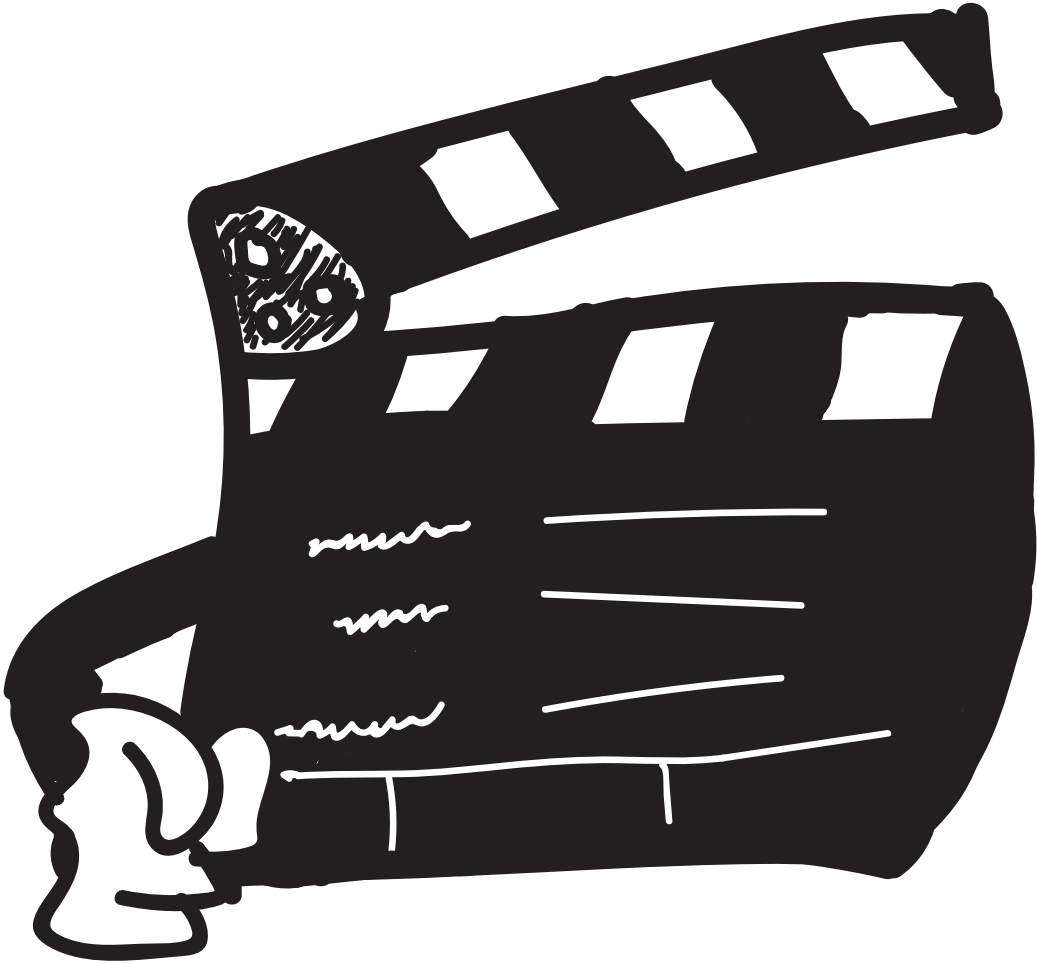
The play is an impressive single-person performance, and Gioia De Cari does an amazing job impersonating the various characters she faces along the way. The performance is aided by a projector, complementing well the statements and movements Gioia makes. Even with this, the theater space still seemed massive relative to the intimate connection created as Gioia's qualifying exam extension is rejected after her father commits suicide.

While the play would resonate with many MIT students, we don't seem like the intended audience. The play emphasized common MIT tropes, like the impersonal number-

ing of buildings and courses, and "drinking from a firehose," giving them a much longer explanation than would be needed for MIT students and creating a more simplistic picture of the institute than many at MIT would recognize.

Towards the end of the play, when Gioia decided to not get a Ph.D., the viewer was left to wonder which of her experiences caused her not to finish with her Ph.D. Grappling with simplifying the complex factors, be it love for theater, trouble making friends, her father's death, imposter's syndrome, or discriminatory comments, the audience is left at a loss to find a simple explanation. At closing, Gioia circles back to her training as a logician, mentioning that a continuum exists between true and false, highlighting the complexity of the graduate school experience.

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Districts and data

Justin Solomon and a cohort of Boston-based researchers use modern computing power to tackle gerrymandering mathematically

By Eli Sanchez

Every 10 years, following the national census, electoral districts in the United States are redrawn. This process is undertaken to satisfy a constitutional requirement that each district within a state — or local district within a jurisdiction — be comprised of roughly the same number of people. In theory, this process is meant to prevent communities from losing or gaining influence in elections through the shifting of a state's population. In practice, redistricting is often exploited by partisan bodies — typically state legislatures — for the very opposite: to manipulate the political clout of certain voting blocs to influence the outcomes of elections.

This opportunistic use of the redistricting process — commonly known as gerrymandering — is widely reviled as one of the most undemocratic practices employed in American politics. It has been leveraged throughout U.S. history to establish advantages for political parties, protect incumbents, and marginalize or empower certain demographics, and is often implicated as the root of many of our political system's ills, such as congressional gridlock, run-away elections, and ideological extremism in government.

Why, then, does a practice so fundamentally undemocratic persist in a nation whose political ethos is imbued with democratic principles?

Justin Solomon, Principal Investigator of the Geometric Data Processing Group at MIT, is a prominent member of the Metric Geometry and Gerrymandering Group (MGGG), a cohort of Boston-based computer scientists and mathematicians that are leveraging modern computing power to study the problem of fairness in redistricting with a level of quantitative rigor that has not been possible until recently.

“From my perspective, one of the big challenges in redistricting is that we lack clear, quantitative standards for evaluating the fairness of redistricting plans” said Solomon. “For that reason, there’s no clear path to a standard that’s easily enforceable and understandable.”

“Our effort, broadly, is... to assemble a clear set of standards and a way to talk about the redistricting problem in a fashion that’s quantitate and that’s fair and easy to apply,” he told *The Tech*. “That includes a lot of different aspects. Everything from understanding the shape of a district and what bearing it has on the outcome of the vote... to understanding the big space of all the different ways of dividing up a state.”

To date, most attempts to contest partisan gerrymanders in court have failed due to the lack of a clear, convincing standard against which to judge them. But Solomon's work, and that of his colleagues in the MGGG holds the potential to fundamentally reshape the debate around gerrymandering by offering a feasible means

of formulating and implementing such a standard for the first time in U.S. history.

Previous work by Solomon involved evaluating the utility of various compactness scores, metrics designed to quantify how “weirdly-shaped” a district is. Some examples of compactness scores include the ratio of a district’s area to the square of its perimeter multiplied by 4π (Polsby-Popper score), or the ratio of a district’s area to the area of the smallest circle that completely encloses it (Reock score).

But a district's compactness doesn't tell the whole story. "The reality is these districts are designed with so many different criteria in mind," Solomon explained. "One is the shape. Others include compliance with civil rights law... [T]here are plenty of districts that really were designed quite carefully to give a particular minority a voice, in which case maybe you needed a crazy shape to pull that off."

Reliable and convincing metrics for quantifying the fairness of redistricting plans must be able to accurately account for a host of complex and interrelated factors. Formulating these metrics remains a thorny, open problem for Solomon and the MGGG. But even once they've identified metrics that are legally practicable, they will have to work out feasible methods for implementing them, a problem that is far from trivial.

“There’s a huge space of plans that follows the rules as we’ve laid them out,” Solomon explained. It would be impractical to require states to iterate through all of them and identify the fairest plan under any given metric.

So, with the brute force approach out of the question, Solomon and his colleagues have had to devise clever procedures for applying these metrics. They have been developing an approach akin to a statistical outlier analysis, a technique that would require detailed, though approximate knowledge of the shape of the distribution of redistricting plans, rather than all possible plans and their associated fairness scores.

“[N]ow, I can look at the plan that was proposed by the legislature and I can say ‘how likely is it that, in that huge set of things that follow the rules, I could have accidentally stumbled upon the one the legislature found?’”

“If you notice that, in the space of plans, your plan is an outlier, then you have a pretty strong argument that there is something nefarious going on.”

Though in its infancy, this type of analysis has already been used to litigate gerrymandering disputes with some success. Notably, in *Common Cause v. Rucho* — a recent case brought before a panel of federal judges — a redistricting plan proposed by the North Carolina state legislature was deemed a partisan gerrymander based on a similar analysis carried out by Jonathan Mattingly, a professor of statistics at Duke University. The plan was rejected as uncon-



LILLIE PAQUETTE

Justin Solomon is a member of the Metric Geometry and Gerrymandering Group (MGGG), a group of Boston-based researchers developing computational algorithms for quantifying the fairness of voting districts to better understand the problem of gerrymandering.

stitutional on these grounds, though the legislature may choose to appeal the decision to the Supreme Court.

The *Rucho* decision is especially interesting because the panel of judges found that their ruling was consistent with existing legal precedent, leaving open the possibility that this type of argument may gain widespread acceptance as a standard for arbitrating gerrymandering disputes. The challenge, then, for Dr. Solomon and the MGGG is establishing a firm enough understanding of the enormous and complex space of redistricting plans for this approach to be applied reliably in legal contexts.

"When you invoke that kind of argument, you have to be confident that you have a representative sample, that you've walked around in this space a sufficient amount and so on," Dr. Solomon explained.

“The ways of dividing up a state or a country or a county or a school district is this huge combinatorial space, and this is really the first time in history that we’ve had the computational power to be able to explore that space with any level of certainty or understanding to make a clear argument.”

Because this space has remained largely unexplored until recently, quite a bit of work remains to establish a firm understanding of it. But even so, Dr. Solomon and his colleagues have decided to pursue the ambitious goal of having workable prototypes of these techniques ready by the 2020 census. This would enable quantitatively rigorous analyses of redistricting plans proposed throughout the country after the census, and potentially offer a feasible route to successfully challenging gerrymanders that arise from the process.

And they're not just trying to develop

analysis techniques that can be used by expert witnesses in court. Rather, they hope to make these analyses accessible to the general public in the form of open-source software packages, giving average citizens a voice in how their electoral districts are constructed.

“We have software that’s under development that does Markov chain Monte Carlo analysis in the space of districting plans,” Solomon told *The Tech*. This technique involves randomly sampling values of a fairness metric and evaluating the probabilities that these values will occur in the space of redistricting plans. The distribution of the metric is then approximately reconstructed based on this data, and subsequent sets are gathered to obtain more accurate approximations.

"We're working really, really hard to make it stable, reliable and easy to use, so that if you're trying to argue about your congressional district, then maybe all you have to do is load in the shape files that come from GNS software and give it a shot!"

"These are heavy-duty mathematical tools that require a little bit of nuanced understanding. But the vision is really to democratize this process."

It's a hopeful vision: a democratic solution to one of the most undemocratic problems plaguing American politics. But if the MGGG succeeds in deploying tools and methodologies for identifying partisan gerrymanders that are able to convince judges, it would represent a monumental step towards eliminating this practice's pernicious effects on our democratic system. And thanks to the efforts of math- and computer-savvy experts like Justin Solomon, as well as modern advances in computing power, a step like this may be within reach for the first time in history.



What's a day in your shoes like?
Write it up for **The Tech's**
Campus Life section!

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Solution, page 12

Instructions: Fill in the grid so that each column, row, and 3 by 3 grid contains exactly one of each of the digits 1 through 9.

Solution, page 3

Instructions: Fill in the grid so that each column and row contains exactly one of each of the numbers 1–6. Follow the mathematical operations for each box.

Solution, page 12

- 1 Isle near Naples
- 6 Bring up
- 10 Photo
- 13 German industrial city
- 14 Red Muppet
- 15 Grandson of Eve
- 17 Unbelieving nature*
- 19 "Jasmine" side dish
- 20 Paltry sum
- 21 Early afternoon
- 22 Big name in sci-fi novels
- 24 Hosiery shade
- 26 Trade org.
- 29 A Fish Called Wanda star
- 30 Elemental bits
- 32 Nightmarish
- 34 Despicable character
- 35 Category
- 37 S&L offerings
- 38 Eroded
- 39 Smart set*
- 43 Year after Y2K
- 44 Senior member
- 45 Make a slip
- 46 What a laser is often

aimed at
47 Craig's boss in Casino
Royale
49 Eminent
53 Exercise based on martial
arts
55 Hard to comprehend
57 Divulge
58 M*A*S*H procedure
60 With 62 Across, a question
of confirmation
62 See 60 Across
63 Gate expectations: Abbr.
64 Remorseful*
68 Sense offense
69 Breach
70 Classy quality
71 Law & Order characters
72 Late-night host Meyers
73 Long stories

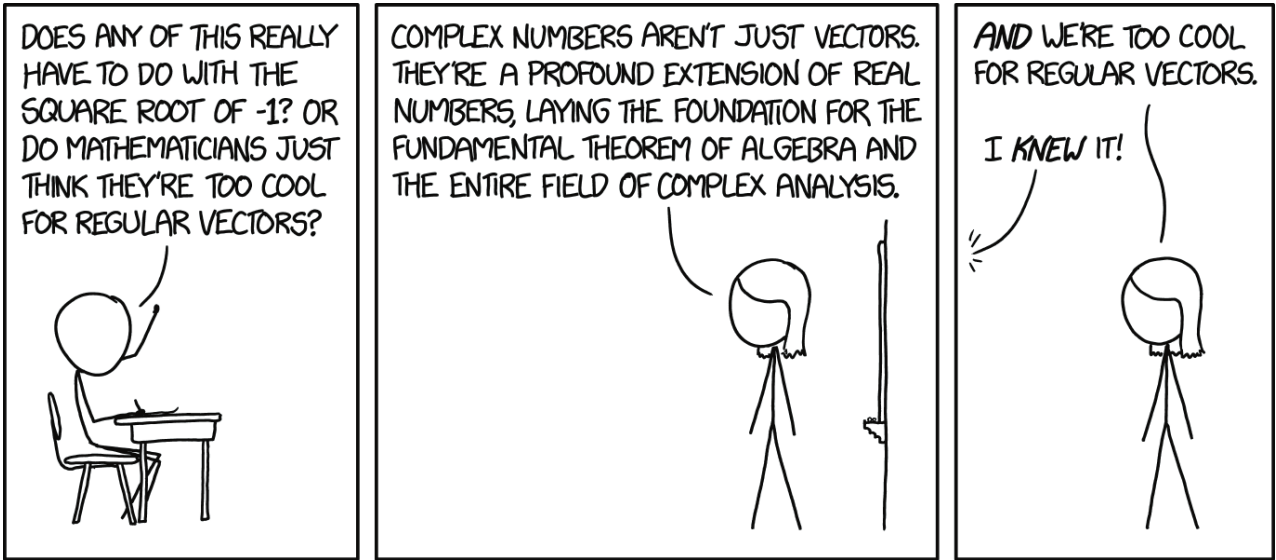
- 1 Contemporary of Piper
- 2 Invite to dinner
- 3 What can precede the three starred answers

4 Social standing, for short
5 Delighted by
6 Inlet, for instance
7 One of two quarterback
brothers
8 Pre-noon hrs.
9 Capitale europea
10 Dire straits
11 Unfriendly
12 Tropical fruits
16 Unforgiving
18 "Little" suffix in music
23 Do up-in-the-air
acrobatics
25 Send forth
27 Systematized knowledge
28 Certain undercover cop
31 Ilditarod participant
33 Be deserving of
36 Swiss surrealist
39 Disclosed
40 "You should try that"
41 Go ashore
42 Syrian __ Republic
43 Murmur complaints
48 Well-being

50 Whirlpool sister brand
51 Beethoven's Third
52 Low pair
54 Enjoys, with "in"
56 Money maker
59 Pencil holders, at times
61 Quiche ingredients
65 Quiche, essentially
66 All the time, in odes
67 Page of history



**A WEBCOMIC OF ROMANCE,
SARCASM, MATH, AND LANGUAGE**
by Randall Munroe



I'm trying to prove that mathematics forms a meta-abelian group, which would finally confirm my suspicions that algebraic geometry and geometric algebras are the same thing.

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Civil Engineer needed!

I'm looking for an engineer to perform some load calculations for a decking project that I am working on.

I'm looking for someone with a background in Statics and Structures. I have a list of specific questions dealing with live loads and dead loads and materials of construction.

Payment will be at a rate of \$40/hr. We can agree upon an estimated number of hours and a completion date when we meet.

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Solution to False Front

from page 10

C	A	P	R	I		R	E	A	R		P	I	C
E	S	S	E	N		E	L	M	O		E	N	O
S	K	E	P	T	I	C	I	S	M		R	I	C
S	O	U		O	N	E		A	S	I	M	O	V
N	U	D	E		A	S	S	N		K	L	I	N
A	T	O	M	S		S	C	A	R	Y		C	U
					I	L	K		I	R	A	S	A
					I	N	T	E	L	L	E	C	T
M	M	I			D	E	A	N		E	R		R
U	P	C			D	E	N	C	H		F	A	M
T	A	E	B	O		D	E	E	P		B	A	R
T	R	I	A	G	E		A	R	E		Y	O	U
E	T	D	S		A	P	O	L	O	G	E	T	I
R	E	E	K		R	I	F	T		G	R	A	C
D	A	S			S	E	T	H		S	A	G	A

Solution to Recruit Me

from page 10

2	9	5	7	4	1	3	6	8
3	6	1	8	5	9	2	7	4
7	4	8	6	2	3	5	9	1
9	2	4	1	6	8	7	5	3
5	8	3	2	9	7	1	4	6
6	1	7	5	3	4	8	2	9
4	7	9	3	1	5	6	8	2
1	5	2	4	8	6	9	3	7
8	3	6	9	7	2	4	1	5

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